Joint Research Centre (JRC)

The European Commission's

Research-Based Policy Support Organisation

Overview of

the Institute for Transuranium Elements

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What is the Joint Research Centre?

European Commission
President Barroso

Commissioner Potočnik
Science and Research
over two DGs

(26 other Commissioners)

Joint Research Centre (JRC)

Research DG (RTD)

Customer DGs: Agriculture, Environment, Enterprise, Safety & Consumer Protection, etc

Basic principles

INDEPENDENCE

from national, industrial and commercial interests

NEUTRALITY

an objective research at the service of Europe and its institutions

SUBSIDIARITY

undertake activities that would benefit from a broad European attention rather then merely tackled at local level

The JRC: a laboratory for EU research

7 Institutes in 5 Member States ≅ 2650 staff (+ 250 competitive)

≅ 300 M€/y budget (+ 40 M€/y competitive)

124 scientific projects (called actions)

IE - Petten The Netherlands

-Institute for Energy

IRMM - Geel Belgium

- Institute for Reference Materials and Measurements

ITU - Karlsruhe Germany

- Institute for Transuranium Elements

IPSC - IHCP - IES - Ispra Italy

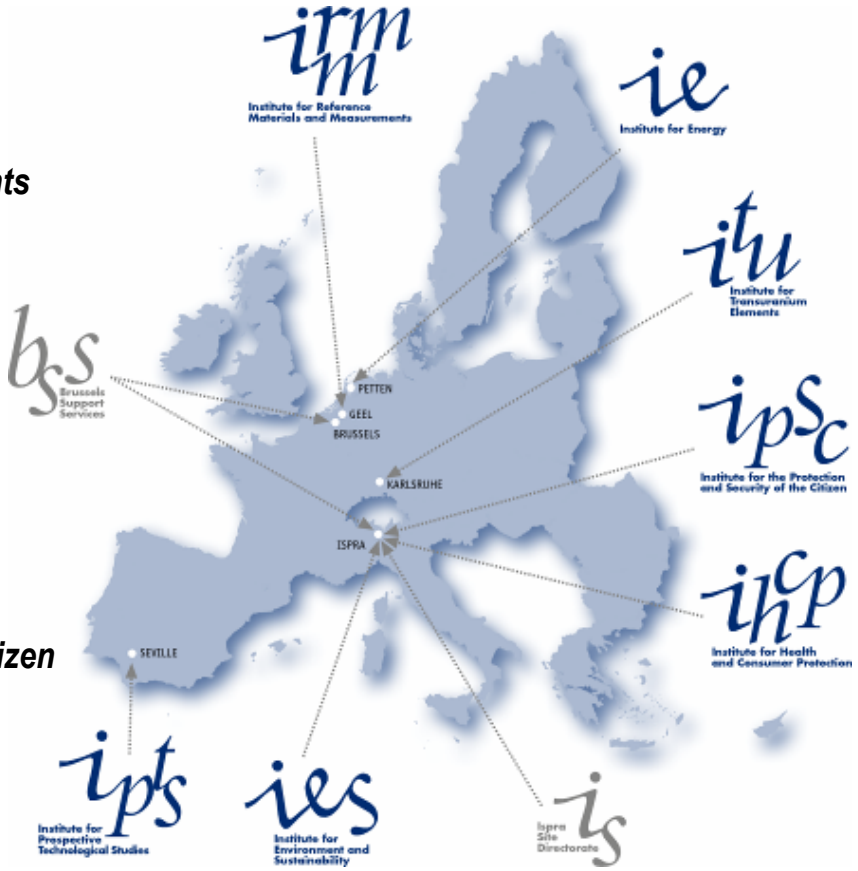
- Institute for Environment and Sustainability

- Institute for Health and Consumer Protection

- Institute for the Protection and Security of the Citizen

IPTS - Seville Spain

- Institute for Prospective Technological Studies



***Mission**: to protect the European citizen against risks associated with the handling and storage of highly radioactive elements.*

Objectives:

- *to serve as a reference centre for basic actinide research*
- *to contribute to an effective safety and safeguards system for the nuclear fuel cycle*
- *to study technological and medical applications of transuranium elements.*

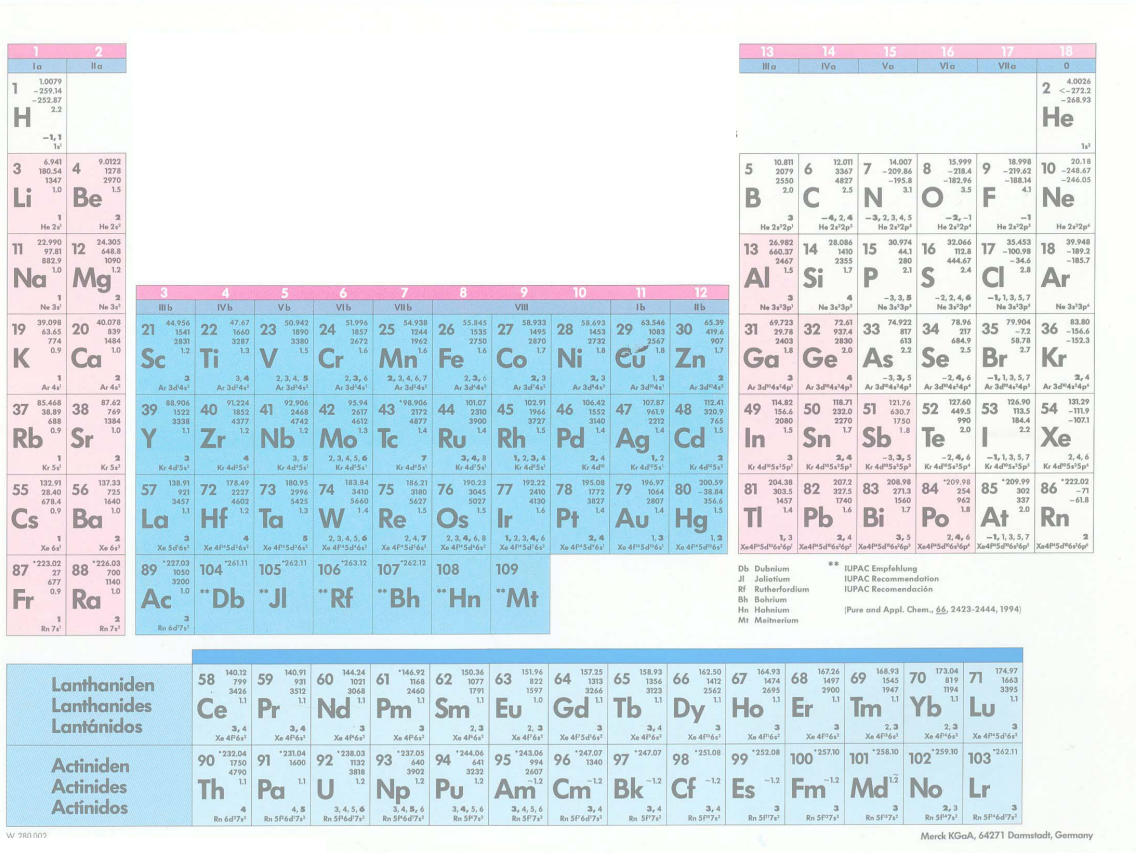
1963-2003

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

≈ 300 staff

Budget: 35 M€/a

Competitive income: 5...6 M€/a



Actinides

5f-electrons

90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
Rn $6d^2 7s^2$	Rn $5f^2 6d^1 7s^2$	Rn $5f^3 6d^1 7s^2$	Rn $5f^4 6d^1 7s^2$	Rn $5f^6 7s^2$	Rn $5f^7 7s^2$	Rn $5f^7 6d^1 7s^2$	Rn $5f^9 7s^2$	Rn $5f^{10} 7s^2$	Rn $5f^{11} 7s^2$	Rn $5f^{12} 7s^2$	Rn $5f^{13} 7s^2$	Rn $5f^{14} 7s^2$	Rn $5f^{14} 6d^1 7s^2$

Transuranium Elements

The 4 pillars of the ITU work programme

Safety of the nuclear fuel cycle

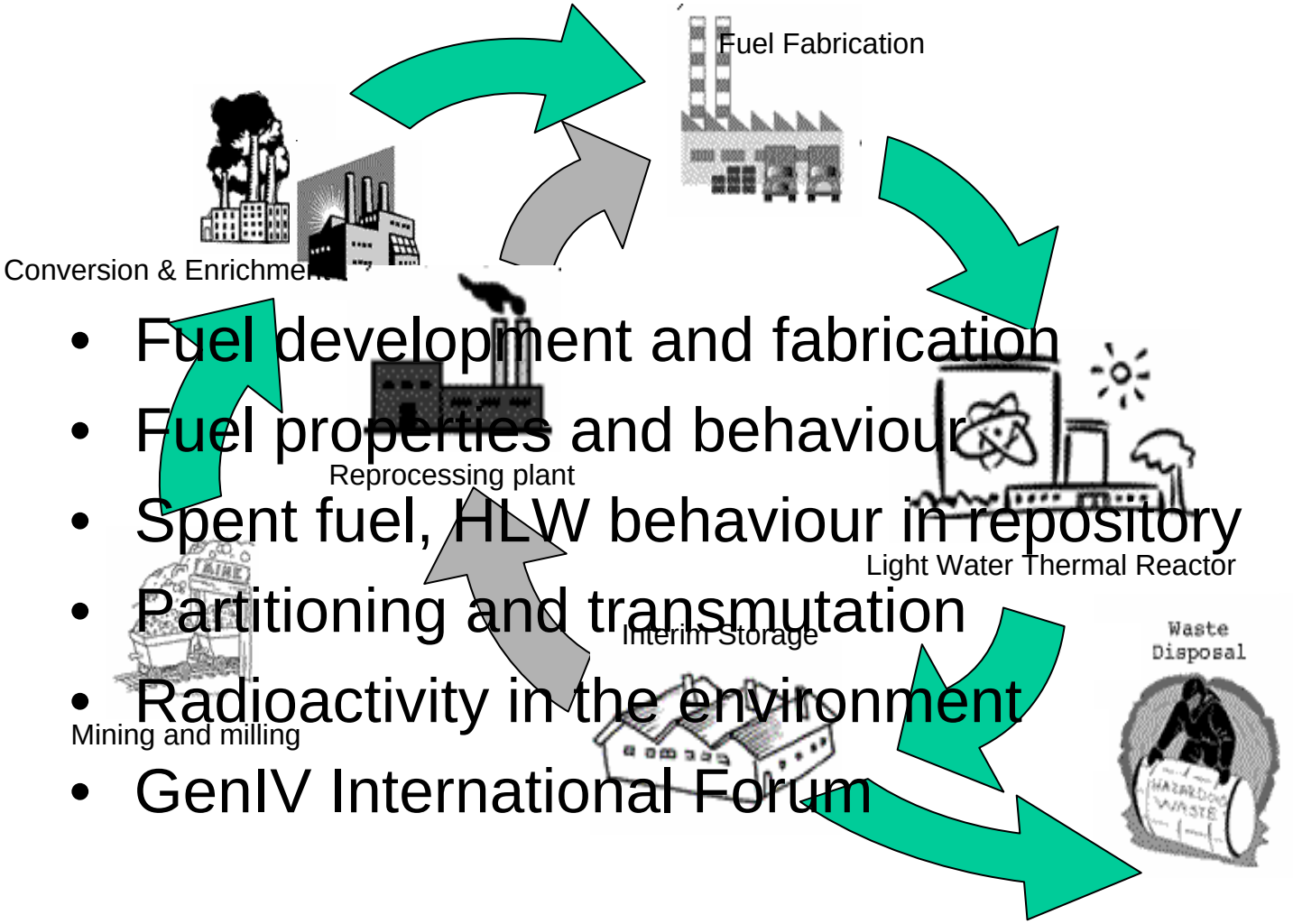
Safeguards and nuclear forensics

Basic actinide science and applications

Education and user facilities

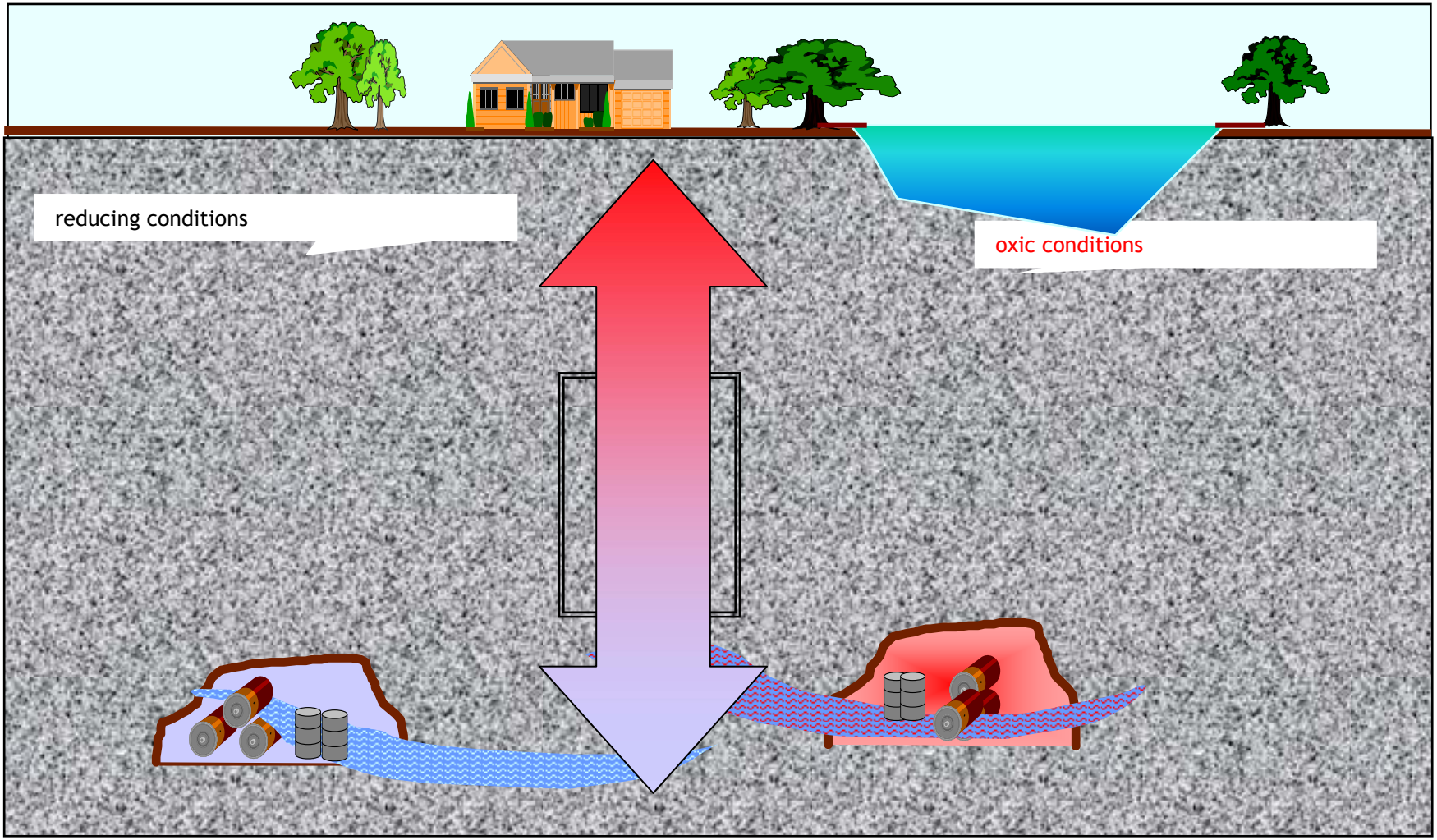
The 4 pillars of the ITU work programme

Safety of the nuclear fuel cycle

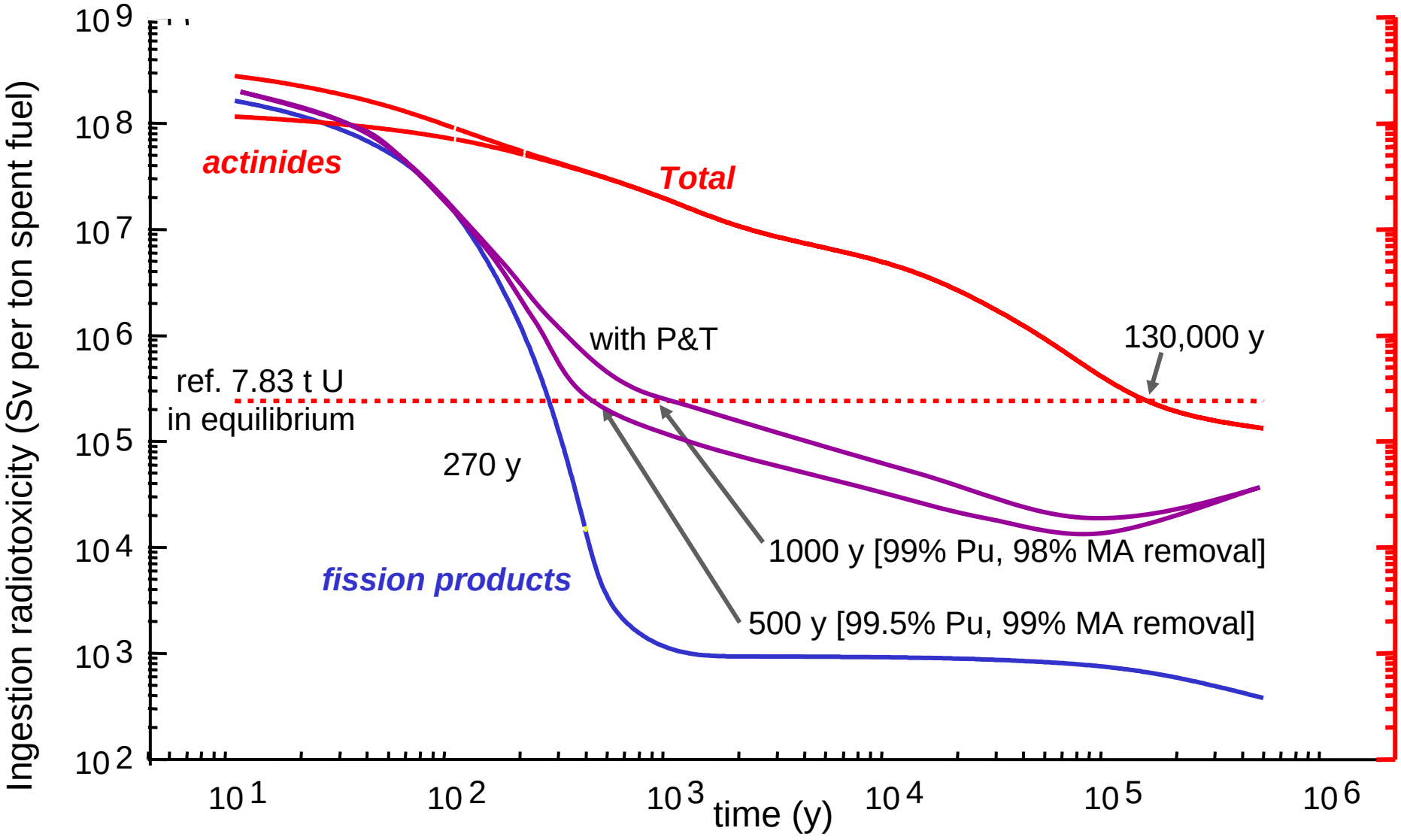


- Fuel development and fabrication
- Fuel properties and behaviour
- Spent fuel, HLW behaviour in repository
- Partitioning and transmutation
- Radioactivity in the environment
- GenIV International Forum

Nuclear Waste Disposal

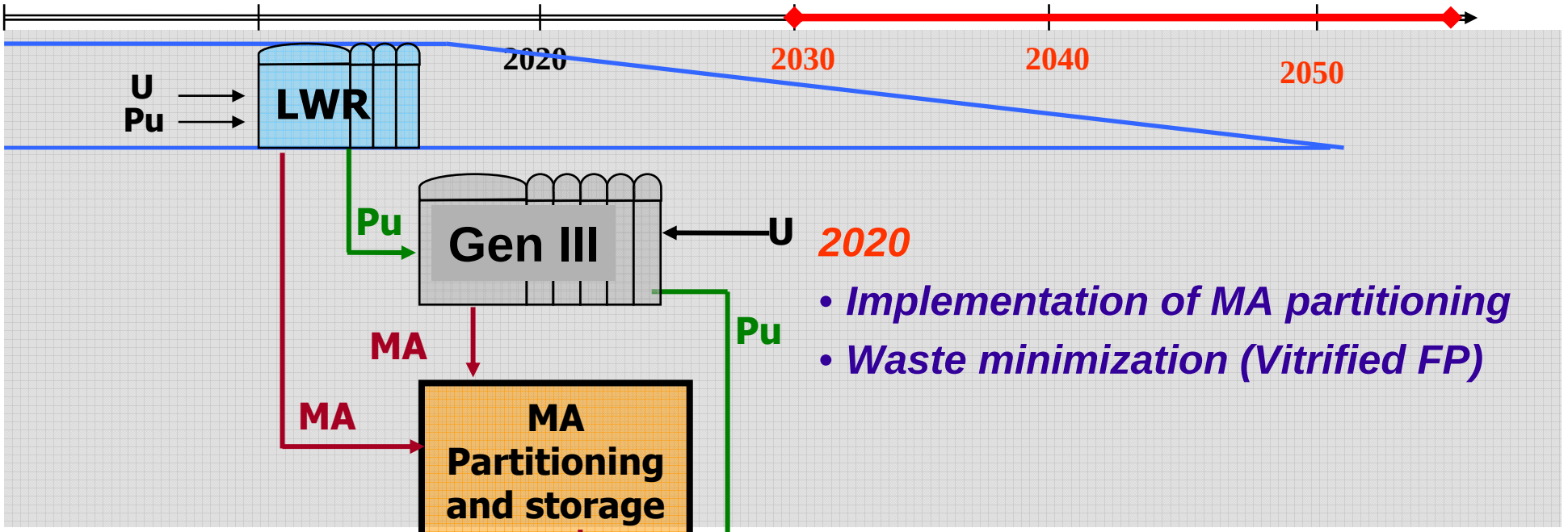


Nuclear Waste Radiotoxicity



evaluation by CEA, FZK and ITU based on ICRP72

Global Actinide Management

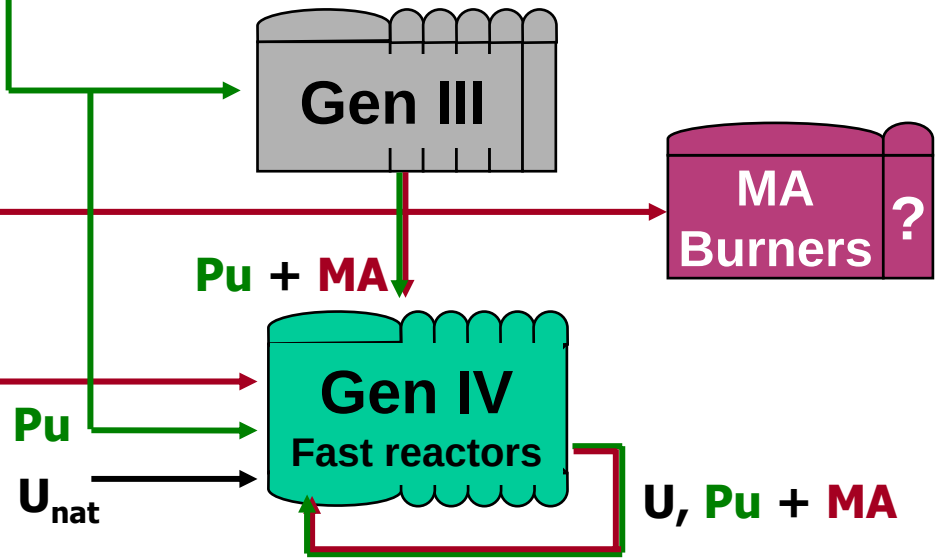


2020

- ***Implementation of MA partitioning***
- ***Waste minimization (Vitrified FP)***

2030/2040

- *GEN III & GEN IV fast reactors*
  - **3rd generation Pu recycling**
  - **Full Pu recycling (GEN IV)**
  - **Recycling of Stored MA**
  - **Dedicated MA burners if needed**



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Safety of the nuclear fuel cycle

Safeguards and nuclear forensics

- R & D in the areas of chemical and radiometric methods for Plutonium facilities (reprocessing and fuel fabrication) and new fuel cycles
- Operation of the On-Site Laboratories (BNG, AREVA)
- Combating illicit trafficking (co-operation with new EU MS, CIS countries, IAEA,…)
- Nuclear forensics analysis of seized nuclear Material
- Micro-particle analysis (U enrichment) for the detection of clandestine nuclear activities: SIMS

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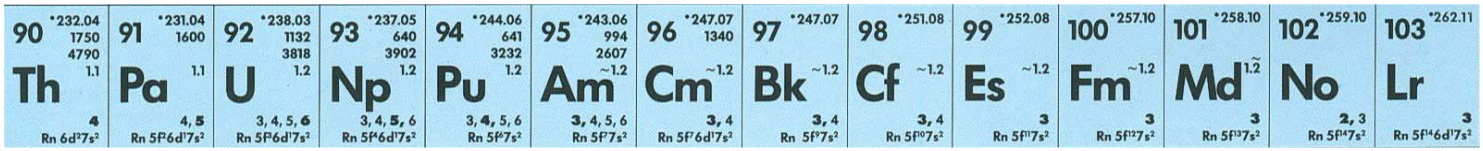
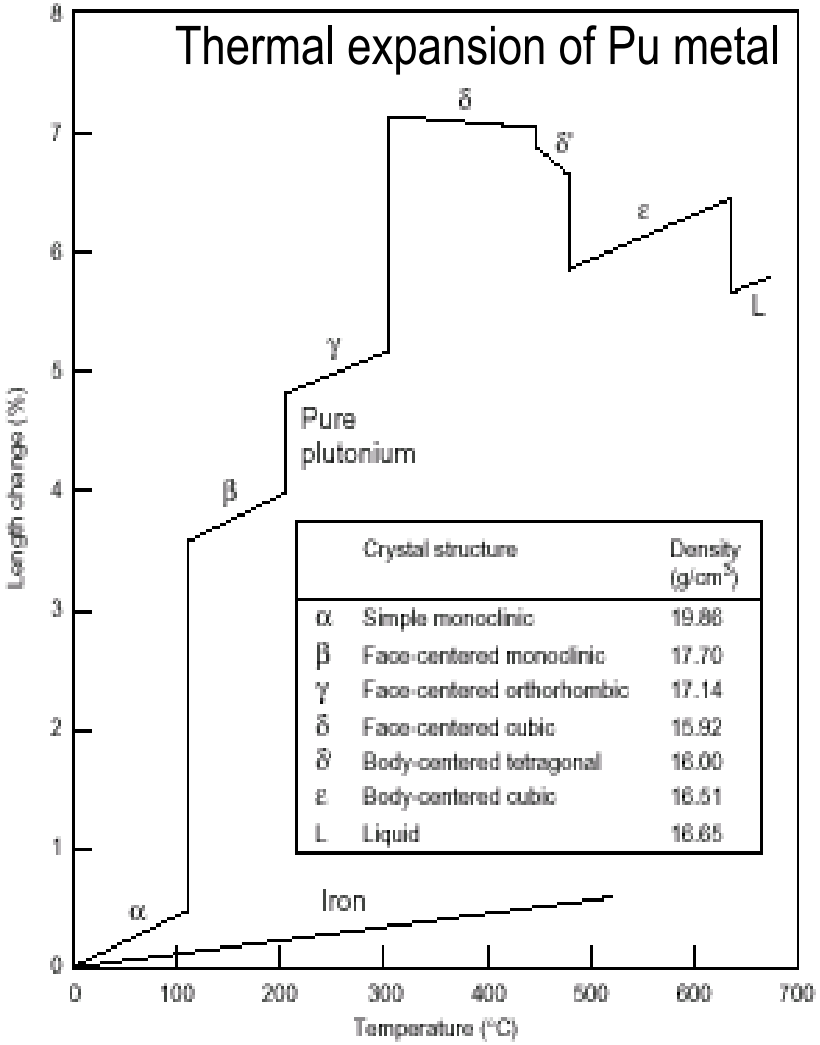
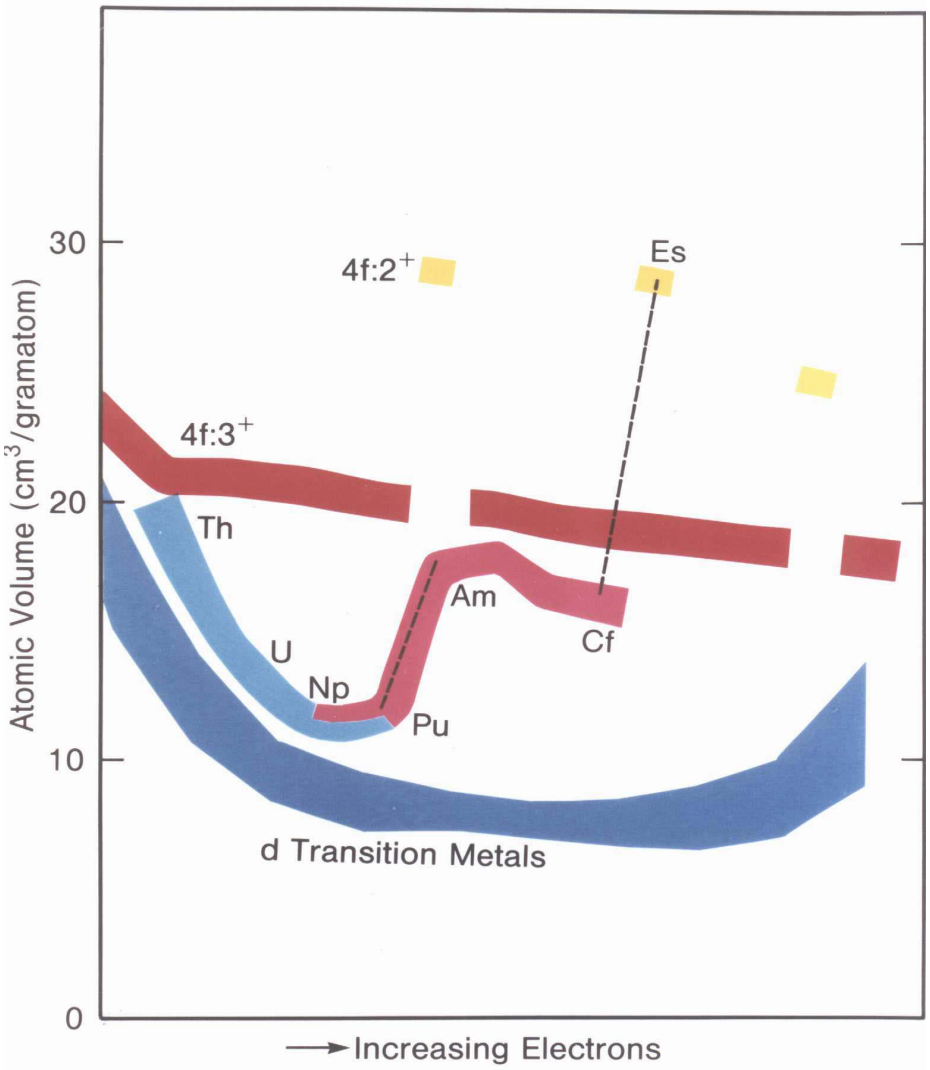
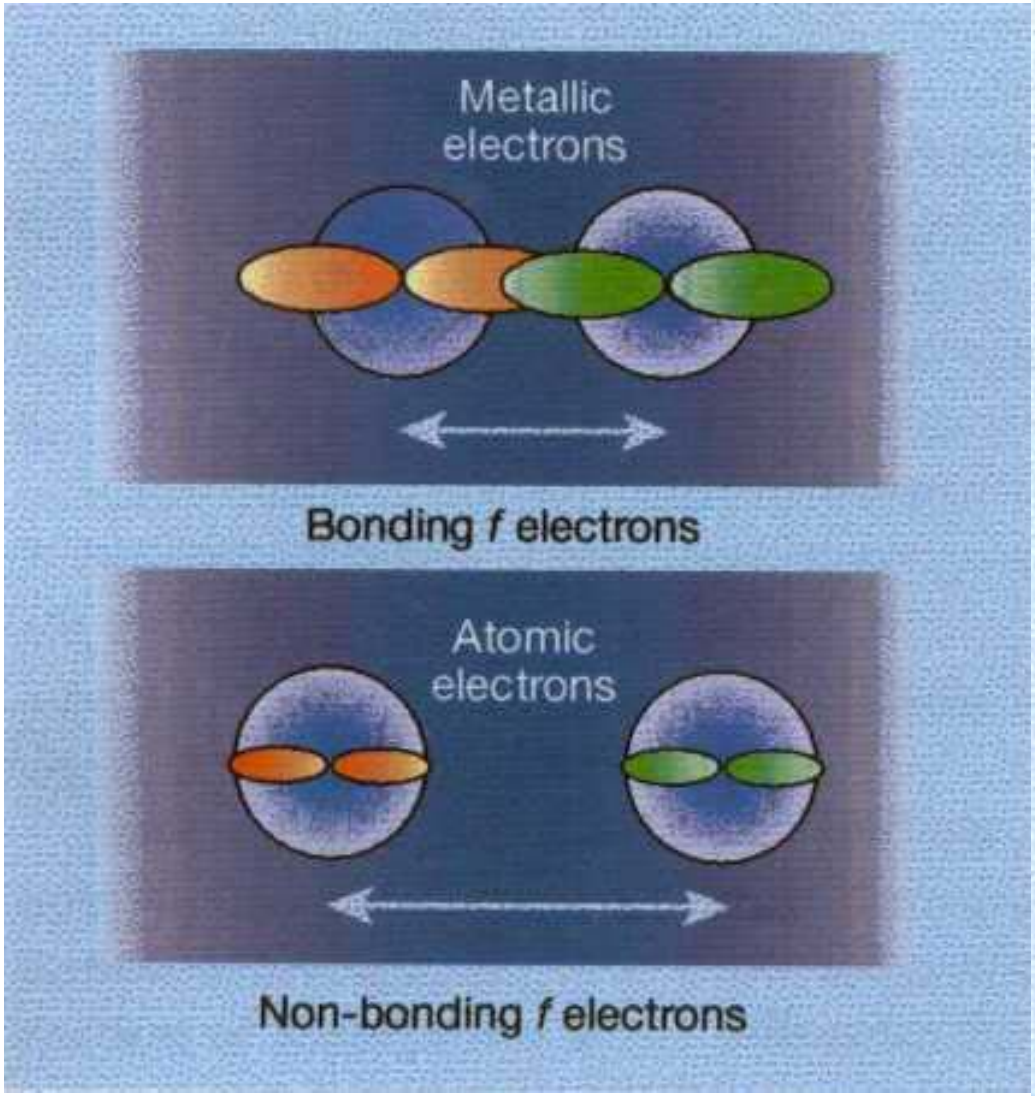


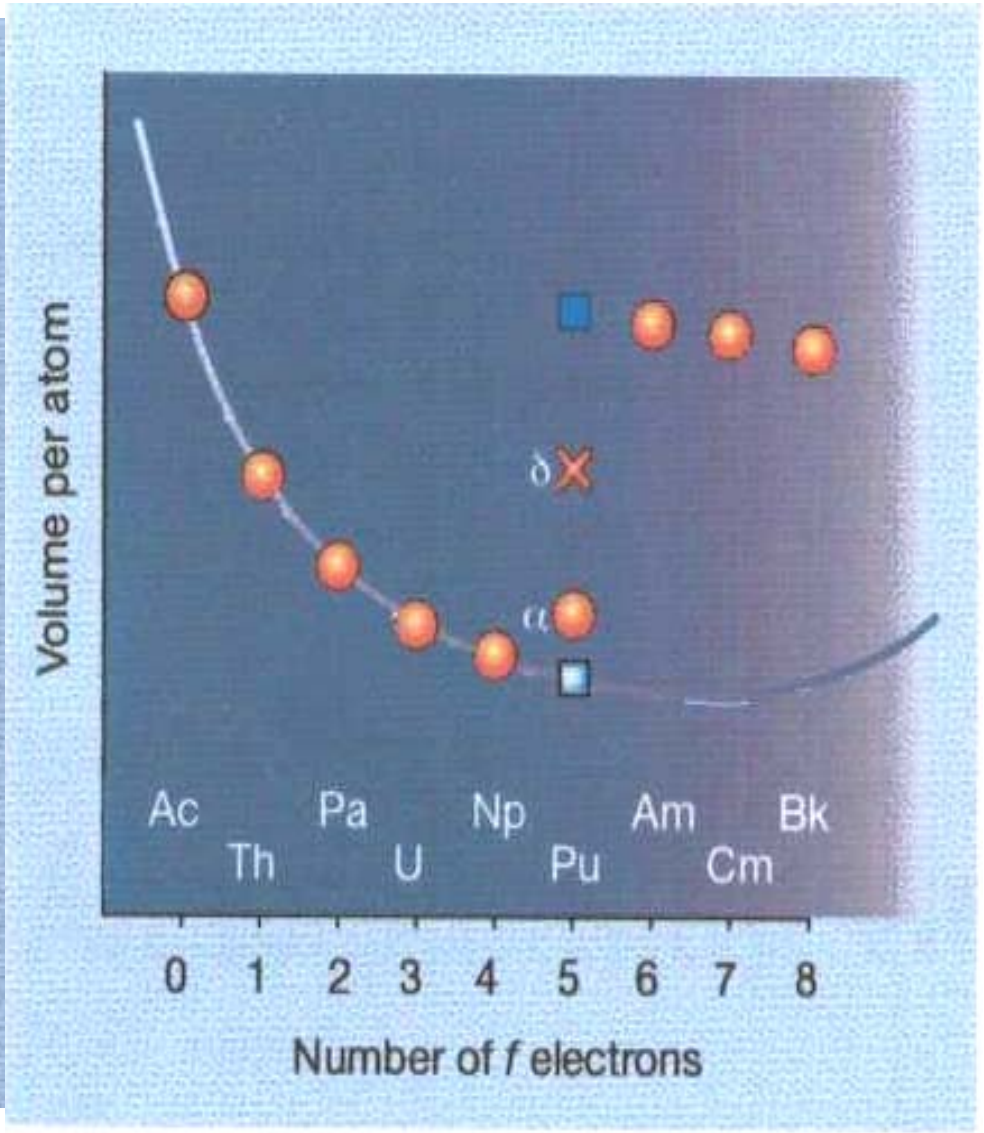
Safety of the nuclear fuel cycle	Safeguards and nuclear forensics	Basic actinide science and applications	Education and user facilities

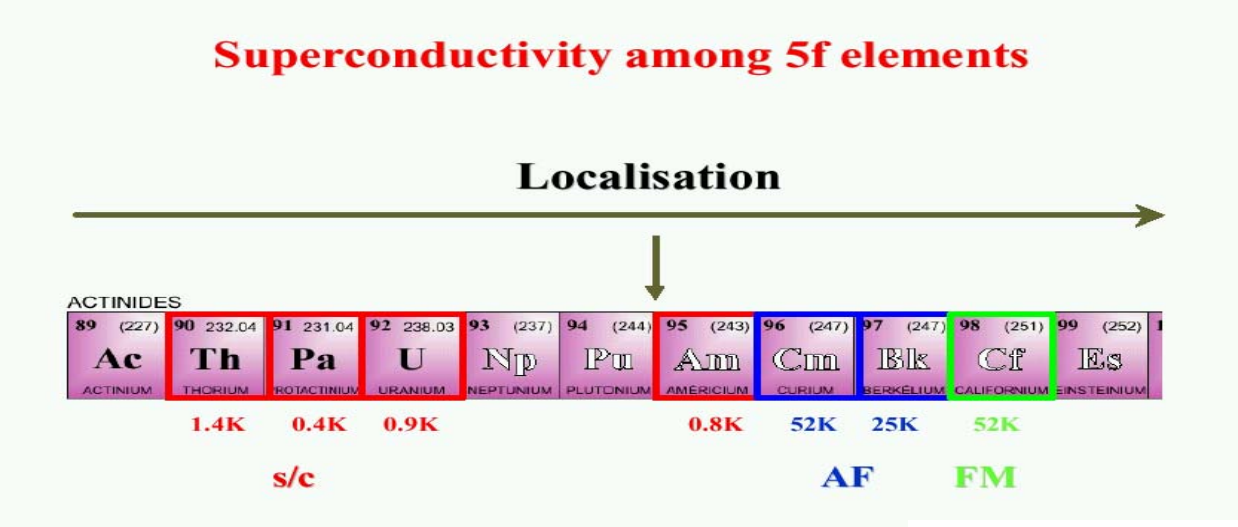

Thermal expansion of Pu metal
Length change (%)
Temperature (°C)
0
100
200
300
400
500
600
700
1
2
3
4
5
6
7
8
α
β
γ
δ
δ'
ε
L
Pure plutonium
Iron
Crystal structure
Density (g/cm³)
α Simple monoclinic 19.86
β Face-centered monoclinic 17.70
γ Face-centered orthorhombic 17.14
δ Face-centered cubic 15.92
δ' Body-centered tetragonal 16.00
ε Body-centered cubic 16.51
L Liquid 16.65


Atomic Volume (cm³/gramatom)
0
10
20
30
4f:2+
4f:3+
Es
Th
U
Np
Pu
Am
Cf
d Transition Metals
Increasing Electrons

Unusual behaviours of the actinides

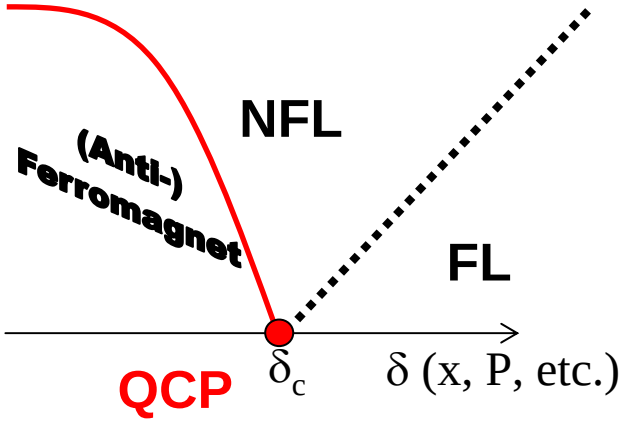


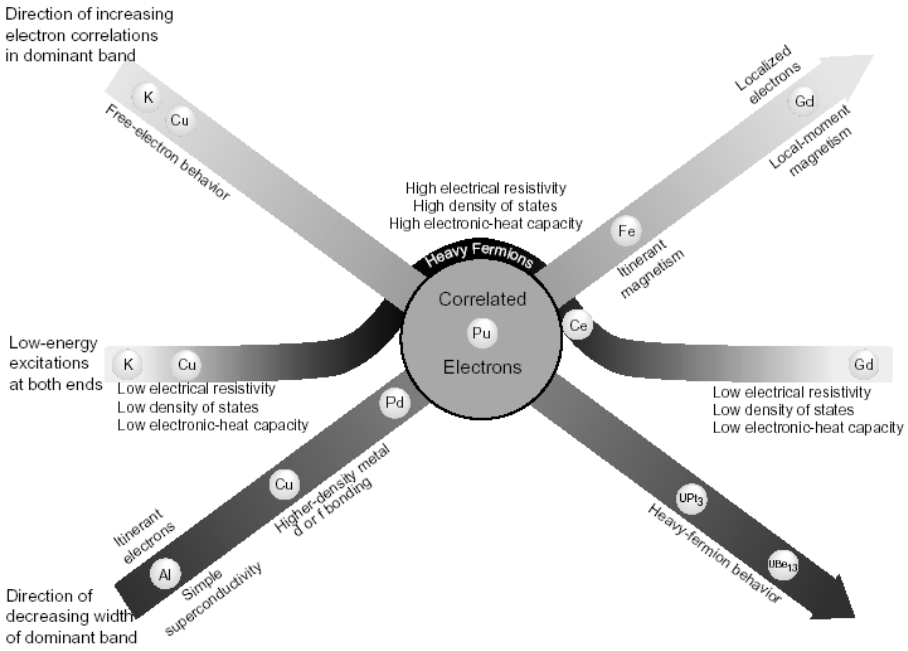




Itinerant – localised crossover

near Pu in 5f electrons





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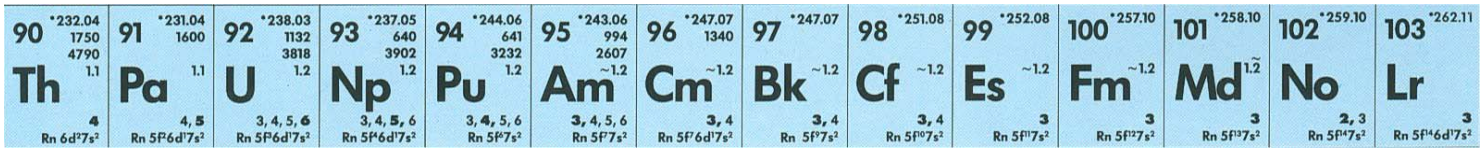
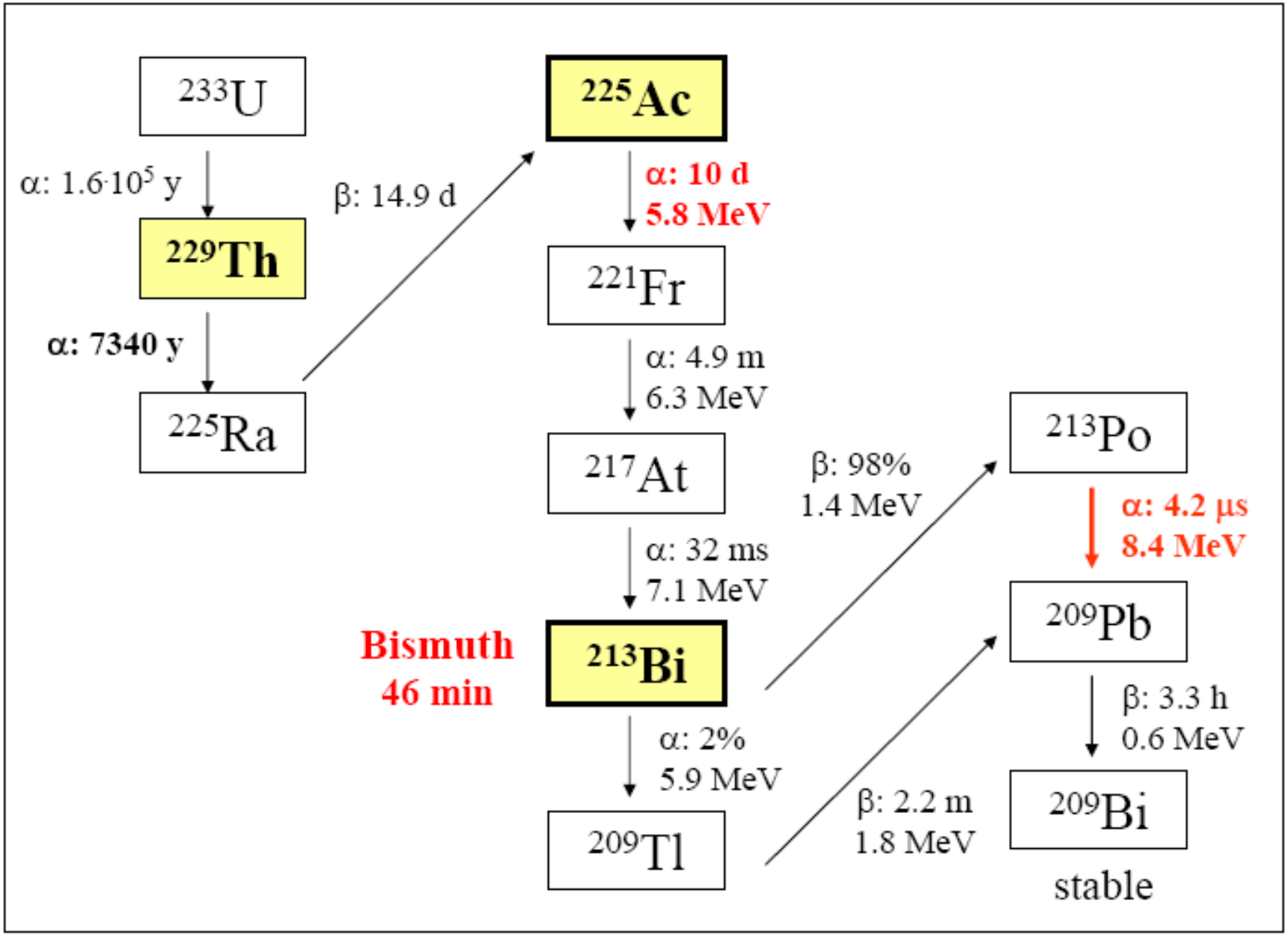


Safety of the nuclear fuel cycle	Safeguards and nuclear forensics	**Basic actinide science and applications**	Education and user facilities

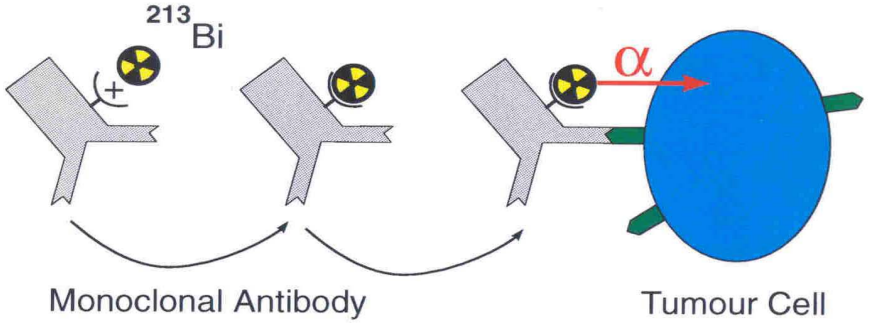
Actinides source of valuable radio-elements



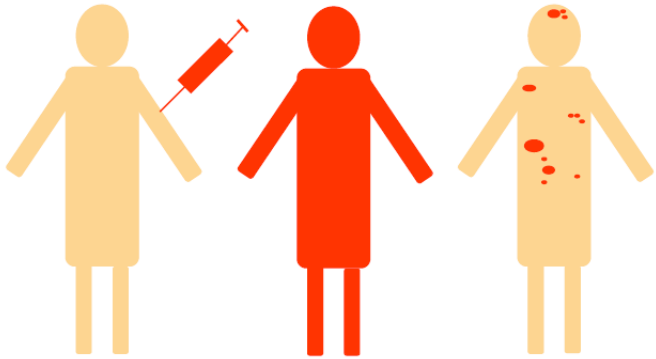
Alpha-immunotherapy for malignant diseases

Cancer therapy with α-emitters is more effective than β, γ treatments (micro-metastasis)

ITU is specialised in handling highly radioactive, in particular α-nuclides



Specific recognition of cancer cells + **Effective killing**



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Basic actinide science and applications

Safety of the nuclear fuel cycle

Safeguards and nuclear forensics

Education and user facilities

- **Summer Schools**

ACTINET Summer School 2008
www.actinet-network.org

- **Trainees, PhD students, Post-Docs**
- **Visiting scientists**
- **User Facility: Actinide User Laboratory**
- **Network of excellence Actinet**
- **Workshops and training courses**
- **Conferences**

38 Journées des Actinides
www.int.pan.wroc.pl/38jda .

Plutonium Futures "The Science" 2008
www.pu2008.org

- **Upgrade and new nuclear databases**
- **Information portals**

Tank you for your attention